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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 7 : D06F 39/02, C11D 17/04, B65D 65/46 — A1

(11) International Publication Number: **WO 00/55415**

(43) International Publication Date: 21 September 2000 (21.09.00)

(21) International Application Number: PCT/EP00/01942

(22) International Filing Date: 7 March 2000 (07.03.00)

(30) Priority Data:
9906172.3 17 March 1999 (17.03.99) GB

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(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: A PROCESS FOR PRODUCING A WATER SOLUBLE PACKAGE

(57) Abstract

A process for producing a thermoformed package comprises the steps of placing a first sheet of film over a forming die having at least one cavity, heating the film to mould the film into the at least one cavity thereby forming at least one recess in the film, placing a composition in the at least one formed recess, and sealing a second sheet of film across the at least one formed recess to produce at least one closed package. Each cavity is cooled to between 2 and 10 degrees C.

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A PROCESS FOR PRODUCING A WATER SOLUBLE PACKAGE

Introduction

The invention relates to a process for producing a thermoformed package of the type comprising the steps of placing a first sheet of formable film over a forming die having a cavity, heating the film to mould the film into the cavity thereby forming a recess in the film, placing a composition in the thus formed recess, and sealing a second sheet of film across the recess to close the package. In particular, the invention relates to such a process for producing a water-soluble package containing a detergent composition.

Detergent compositions for the machine washing of laundry are provided in many forms. Probably the most prevalent form of laundry detergent is washing powder or granules. A problem with the use of these forms of detergent is that the product needs to be dosed into the machine in such a way that the detergent is quickly and thoroughly dissolved in the wash water of the machine without coming into contact with the laundry in a solid form. In this regard many dosing devices which overcome this problem have been proposed. One such device disclosed in European Patent Nos. 0 343 070 and 0 343 069 teaches the use of a flexible fabric sock which holds the particulate detergent in the machine, the fabric of the sock being permeable to water so as to allow water enter the sock and carry the detergent out of the sock through the fabric walls in the form of an aqueous solution. More recently unit dose forms of detergent have been proposed in the form of compressed tablets of detergent powder. A problem encountered with the provision of detergent tablets is that the tablets need to be strong enough to withstand storage and transport, yet weak enough

to disintegrate and dissolve quickly in the washing machine. A further problem is the need to prevent the tablets "posting" in the porthole and between the drums of conventional washing machines. More recently these problems have been overcome by the provision of detergent tablets having specific chemical disintegrants which allow quick disintegration of the tablets in the aqueous environment of a washing machine, and by the provision of loosely fitting net bags which aid tablet disintegration and prevent "posting". However, as many of the current detergent tablets contain bleach and other irritant substances, he problem of handling the tablets remains.

The provision of detergent compositions in water-soluble films has been known for some time. Most of the documents relating to this subject describe water soluble film envelopes formed using a vertical form-fill-seal (VFFS) route. A problem with envelopes produced using this VFFS method is that, due to the constraints of the process, the resultant envelopes have seals which incorporate defined weak points where the seals overlap at corners. This results in envelopes, which are easily corrupted as a result of impacts suffered during transport. In an attempt to overcome the problems associated with such VFFS envelopes, European Patent Application No. 0 608 910 describes thermoformed water soluble packages for pesticidal compositions of the above mentioned type, which packages include a seal which does not have any angular intersections with itself. While this specification does provide a partial solution to the problem of weak seals, the thermoforming of water-soluble films results in formed packages having many other weak points. Moreover, the packaging and transport of such packages subjects the formed packages to considerable impact forces. A further problem inherent with thermoforming processes, particularly when the thermoformed package is to

contain liquid, is contamination of the seal with liquid, resulting in poor sealing of the packages.

It is an object of the invention to overcome at least some of the above problems.

Statements of Invention

According to the invention, there is provided a process for producing a thermoformed package of the above-mentioned type, the process being characterised in that the at least one cavity of the forming die is cooled. Typically, the or each cavity is cooled to less than 20, preferably less than 15 degrees C. In a preferable embodiment of the invention, the or each cavity is cooled to between 2 and 15 degrees C, more preferably to between 5 and 12 degrees C, and ideally to between 7 and 9 degrees C. Most preferably, the or each cavity is cooled to about 8 degrees C. Generally, each cavity is cooled throughout the thermoforming process. Various cooling means are envisaged such as for example passing liquid coolant through the walls or body of the cavities or the forming die, however many other cooling means will be apparent to those skilled in the art. Without being limited to theory, the cooling of the dies prevents or hinders the formed recesses shrinking subsequent to their being formed. Prevention of shrinkback is important in that if not prevented it can result in spillage of the contents of the recesses onto the sealing areas of the films which results in incomplete sealing of the recesses.

Once formed, the or each recess is preferably substantially retained in its formed orientation by the application of a vacuum through the or each cavity. Ideally, the vacuum is maintained at least until completion of the sealing step. In this way, shrinkback of the formed recesses is minimised,

thus preventing spillage of the composition contained in the formed recesses onto the sealing area of the film. The extent of vacuum to be applied should preferably be sufficient to retain the formed recesses in their formed orientation without unduly deforming or otherwise damaging the film. In this regard the exact pressure to be applied is variable and depends on the film being formed, the type of composition being added to the recesses, and the temperature and humidity of the forming environment. Typically however, a vacuum of between 0.1 and 10 Bar will be used. The vacuum is preferably applied through at least one aperture in the at least one forming cavity. Ideally, the or each cavity will include a plurality of apertures through which the vacuum is applied. In one embodiment of the invention, the at least one cavity may comprise a porous material through which the vacuum may be applied.

Preferably, the or each cavity in the forming die has a curved edge, wherein at least a portion of the curved edge is formed from a resiliently deformable material. Ideally, a predominant portion, and most preferably a whole, of the curved edge is formed of a resiliently deformable material. In one embodiment of the invention, the curved edge comprises an annular gasket of resiliently deformable material, which gasket is mounted in a circumferential groove around the or each cavity. In such a case, the gasket should be dimensioned such that, when mounted in the groove, an exposed surface of the gasket should be flush with a surface of the cavity.

In a further aspect of the invention, the or each cavity is surrounded by a raised flange, wherein at least a portion, and ideally most or all, of the raised flange comprises resiliently deformable material. In such a case, the curved edge and flange are preferably integrally formed. Thus, a

single gasket preferably comprises the curved edge and the flange. In one embodiment of the invention, a ratio of a width of the flange to a minor diameter of the cavity is between 1:50 and 1:10, preferably about 1:12.

The resiliently deformable material is preferably silicone rubber, however other suitable material performing the same function are envisaged.

In the thermoforming step of the process of the invention, the film is heated by a heating plate which may be flat or may have at least one concave depression which in use overlies the at least one cavity, wherein the heating step involves the step of bringing the film into intimate contact with the or each depression. The use of a heating plate having concave depressions ensures that the film when heated thermoforms uniformly which results in a package having less weak spots.

In one embodiment of the invention, intimate contact between the film and the concave depression is achieved by exerting a vacuum between the depression and the film. In this regard the depression may include holes through which the vacuum may be pulled. Alternatively, the heating plate may comprise a porous material. When a vacuum is exerted in this manner, the vacuum should ideally comprise a pressure of up to 1 Bar, and preferably be less that 0.6 Bar. In an alternative embodiment of the invention, the film is forced into intimate contact with the concave depression by blowing air against it. Typically the pressure of the blown air will be less than 5 Bar, preferably less than 3 Bar. The heating plate preferably has a temperature in the region of 100 to 120 degrees C, and ideally is approximately 110 degrees C. Although the time the film contacts the heating plate depends to a large extent on the type of film used and the

temperature of the heating plate, the time of contact between the film and the plate should be in the region 0.1 to 5 seconds, preferably 0.5 to 1seconds, ideally approximately 700 milliseconds.

In a particularly preferred embodiment of the invention, the at least one concave depression is circular. In such a case it is preferable that the ratio of the diameter of the depression to the ratio of the depth of the depression is between 4:1 and 50:1, typically between 5:1 and 40:1, suitably between 7:1 and 30:1, ideally between 8:1 and 20:1. In a most preferable embodiment, the ratio is approximately 10:1. Thus in an embodiment of the invention which will be described in further detail below, the concave depression is circular having a diameter of approximately 50 mm and a depth of about 5mm.

Ideally, the concave depression has a radiussed edge. Preferably the depression has a base having a radius of curvature, wherein the ratio of the radius of curvature of the base to the radius of curvature of the edge is preferably between 5:1 to 1:1, and most preferably is about 2:1. Typically, a single plate may have a plurality of concave depressions which in most instances will correspond to an equal number of cavities in the forming die. In a further embodiment of the invention, the or each cavity in the forming die is cooled with respect to ambient temperature. In this regard, the or each cavity may be cooled to less that 20, suitably less than 15, preferably less that 10, and ideally about 8 degrees C. Means for cooling the cavities will be well known to this skilled in the art.

In one embodiment of the invention, the film is a water soluble film, preferably polyvinyl alcohol, or a polyvinyl

alcohol derivative. Preferably the film has a thickness of between 10 and 1000 microns. Ideally the film has a thickness of between 20 and 80 microns, most preferably between 40 and 60 microns. In one embodiment of the invention, an exterior surface of the film is treated with BITREX.

The composition contained within the package may be a liquid, a gel or a paste or other type of fluent composition. Preferably the liquid is a liquid having a viscosity between 100 and 1000 centipoise, preferably between 300 and 800 centipoise, more preferably between 500 and 700 centipoise, and ideally about 600 centipoise, when measure at 20 degrees C at 105/seconds. In a preferred embodiment of the invention the fluent composition is present in an amount of between 10 and 500mls, preferably between 10 and 100mls, most preferably between 10 and 50mls. Suitably, the capsule contains between 20 and 30 mls of fluent composition. Preferably, the liquid comprises a detergent or any other type of active agent used in the machine washing of laundry or dishes. In another embodiment of the invention, the package contains a bathing or shower gel composition or any other type of personal care composition. Ideally the composition has a viscosity of up to 2000 centipoise, preferably between 100 and 800 centipoise, most preferably approximately 600 centipoise, when measured at 105/second at 20 degrees C. Ideally the composition is non-aqueous, however the composition may comprise between 1 and 5% water.

DETAILED DESCRIPTION OF THE INVENTION

The invention will be more clearly understood from the following description of some embodiment thereof, given by way of example only.

EXAMPLE

In this example a thermoforming process is described where a number of recesses are formed in a single sheet using a forming die having a plurality of cavities with dimensions corresponding generally to the dimensions of the packages to be produced. Further, a single heating plate is used for moulding the film for all the cavities, and in the same way a single sealing plate is described.

A first sheet of polyvinyl alcohol film is drawn over a forming die so that the film is placed over the plurality of forming cavities in the die. Each cavity is generally dome shape having a round edge, the edges of the cavities further being radiussed to remove any sharp edges which might damage the film during the forming or sealing steps of the process. Each cavity further includes a raised surrounding flange. In order to maximise package strength, the film is delivered to the forming die in a crease free form and with minimum tension. In the forming step, the film is heated to 100 to 120 degrees C, preferably approximately 110 degrees C, for up to 5 seconds, preferably approximately 700 micro seconds. A heating plate is used to heat the film, which plate is positioned to superpose the forming die. The plate includes a plurality concave depressions which correspond to the recesses on the forming die. During this preheating step, a vacuum is pulled through the pre-heating plate to ensure intimate contact between the film and the pre-heating plate, this intimate contact ensuring that the film is heated evenly and uniformly (the extent of the vacuum is dependant of the thermoforming conditions and the type of film used, however in the present context a vacuum of less than 0.6 bar was found to be suitable) Non-uniform heating results in a formed package having weak spots. In addition to the vacuum,

it is possible to blow air against the film to force it into intimate contact with the preheating plate.

The thermoformed film is thus moulded into the cavities forming a plurality of recesses which, once formed, are retained in their thermoformed orientation by the application of a vacuum through the walls of the cavities. This vacuum is maintained at least until the packages are sealed. Further, the cavities are cooled to 8 degrees C by the circulation of liquid coolant through the forming die. Once the recesses are formed and held in position by the vacuum, the composition, in this case a liquid detergent, is added to each of the recesses. The fact that formed recesses are retained in their formed orientation by the vacuum substantially prevents the formed film shrinking, which if not prevented could result in some of the composition in the recesses spilling or splashing out of the recess and onto that portion of film which overlies the sealing flange resulting in poor sealing. A second sheet of polyvinyl alcohol film is then superposed on the first sheet covering the filled recesses and heatsealed thereto using a heating plate. In this case the heat sealing plate, which is flat, operates at a temperature of about 140 to 160 degrees centigrade, and contacts the films for 1 to 2 seconds and with a force of 8 to 30kg/cm2, preferably 10 to 20kg/cm2. The raised flanges surrounding each cavity ensures that the films are sealed together along the flange to form a continuous closed seal. The radiussed edge of each cavity is at least partly formed a by a resiliently deformable material, such as for example silicone rubber. This results in reduced force being applied at the inner edge of the sealing flange to avoid heat/pressure damage to the film.

Once sealed, the packages formed are separated from the web of sheet film using cutting means. At this stage it is

possible to release the vacuum on the die, and eject the formed packages from the forming die. In this way the packages are formed, filled and sealed while nesting in the forming die. In addition they may be cut while in the forming die as well.

During the forming, filling and sealing steps of the process, the relative humidity of the atmosphere is controlled at ca. 50%. This is done to maintain the heat sealing characteristics of the film. When handling thinner films, it may be necessary to reduce the relative humidity to ensure that the films have a relatively low degree of plasticisation and as such tend to be stiffer resulting in easier handling. The actual specific RH of the atmosphere needed will vary according to the temperature of the environment and the type of film used, however for temperatures in the region of 20 degrees C, the RH should be in the region of 30 to 50% depending on the thickness and elasticity of the film.

The invention is not limited to the embodiments hereinbefore described which may be varied in both construction, detail and process step without departing from the spirit of the invention.

CLAIMS

1. A process for producing a thermoformed package comprising the steps of:-

- placing a first sheet of film over a forming die having at least one cavity;

- heating the film to mould the film into the at least one cavity thereby forming at least one recess in the film;

- placing a composition in the at least one formed recess; and

- sealing a second sheet of film across the at least one formed recess to produce at least one closed package,

the process being characterised in that the at least one cavity is cooled.

2. A process as claimed in claim 1 in which the at least one cavity is cooled to between 2 and 10 degrees C.

3. A process as claimed in claims 1 in which the or each cavity is cooled to approximately 8 degrees C.

4. A package obtainable by the process of any of claims 1 to 3.

INTERNATIONAL SEARCH REPORT

Inte ...nal Application No
PCT/EP 00/01942

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 D06F39/02 C11D17/04 B65D65/46

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 D06F C11D B65D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 92 17382 A (RHONE POULENC AGRICULTURE) 15 October 1992 (1992-10-15) column 9, line 19 -column 10, line 2; claims 1,18,26,29 ---	1-4
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A	EP 0 608 910 A (RHONE POULENC AGRICULTURE) 3 August 1994 (1994-08-03) cited in the application column 5, line 30 -column 6, line 21 ---	1-4
A	DE 12 87 502 B (CLOUD MACHINE CORP. SKOKIE, ILL.) column 1, line 1-8; claim 1 -----	1-4

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
25 July 2000	31/07/2000

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Information on patent family members

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